



Victorian Certificate of Education 2003

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

Letter

Figures

Words

ENVIRONMENTAL SCIENCE

Written examination 1

Wednesday 11 June 2003

Reading time: 2.45 pm to 3.00 pm (15 minutes)

Writing time: 3.00 pm to 4.30 pm (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	6	6	70
			Total 90

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved graphics calculator (memory cleared) and/or one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 15 pages.
- Answer sheet for multiple-choice questions.

Instructions

- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.
- All written responses must be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other electronic communication devices into the examination room.

SECTION A – Multiple-choice questions**Instructions for Section A**

Answer all questions in pencil on the answer sheet for multiple-choice questions.

A correct answer scores 1, an incorrect answer scores 0. Marks will **not** be deducted for incorrect answers. No mark will be given if more than one answer is shown for any question.

Question 1

Which of the following is a source of renewable energy that does **not** generate greenhouse gases?

- A. natural gas
- B. biomass
- C. wind
- D. coal

Question 2

Which of the following directly contributes to increased atmospheric concentrations of greenhouse gases?

- A. use of solar hot water systems
- B. destruction of the earth's ozone layer
- C. burning of coal in electricity generating coal stations
- D. production of electricity from uranium in power stations

Question 3

The natural greenhouse effect is caused mainly by the

- A. direct trapping of solar radiation as it moves down through the atmosphere.
- B. trapping by the atmosphere of radiation re-emitted by the earth's surface.
- C. inability of solar radiation to penetrate the atmosphere.
- D. increase in greenhouse gases due to human activity.

Question 4

Which of the following is the most likely effect of the enhanced greenhouse effect?

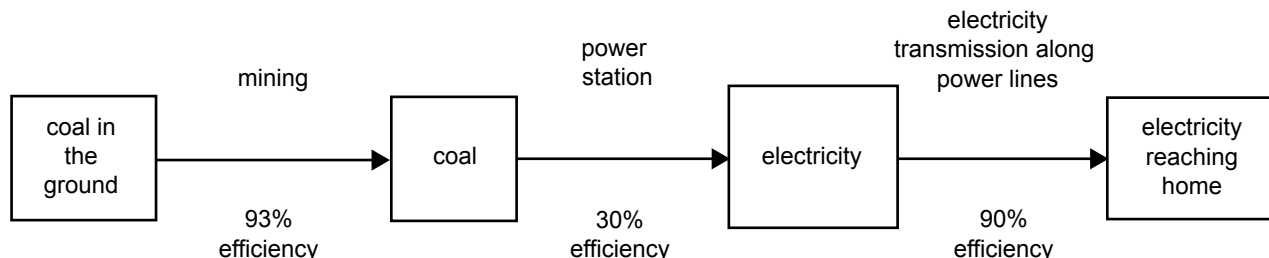
- A. cooler nights
- B. higher sea level
- C. a significant reduction in atmospheric oxygen concentrations
- D. lower levels of ultraviolet radiation reaching the earth's surface

Use the following information to answer Questions 5 and 6.

Coal is dug from the ground and stored in a coal pile. In a power station, the coal from the pile is burned in a boiler to produce steam which drives a turbine to produce electricity.

The electricity is transmitted through a series of power lines to homes. The efficiency of each step in the process is shown in the diagram below.

One kilogram of coal releases 6000 kJ of energy when it is burnt.



Question 5

What percentage of the energy in coal in the ground reaches the home?

- A. 10
- B. 25
- C. 90
- D. 213

Question 6

How much energy is **not** converted to electricity when one kilogram of coal is burnt in a power station?

- A. 800 kJ
- B. 2100 kJ
- C. 4200 kJ
- D. 5580 kJ

Question 7

Species richness is measured by the

- A. number of species.
- B. total number of individuals.
- C. relative abundance of different species.
- D. number of ecosystems in which a species lives.

Question 8

Ecosystem diversity is the variety of

- A. endemic species in an area.
- B. plants and animals in a particular ecosystem.
- C. habitats that are occupied by a single species.
- D. types of natural communities, habitats and ecological processes.

Question 9

Which of the following is **not** a threat to biodiversity?

- A. inbreeding
- B. loss of pollinators
- C. genetic swamping
- D. loss of exotic competitors

Question 10

An endemic species is defined as a species that is

- A. low in genetic diversity.
- B. at a high risk of extinction.
- C. confined to a particular locality.
- D. introduced from a different country.

Use the following information to answer Questions 11, 12 and 13.

During an environmental assessment at a proposed site for a shopping centre, a scientist discovers a species of butterfly in remnant native vegetation next to the site.

Question 11

The butterfly species is regarded as endangered.

Endangered is a lower level of threat than

- A. exotic.
- B. critical.
- C. endemic.
- D. vulnerable.

Question 12

The abundance of butterflies was measured in five randomly located survey sites, each 10 m² in area, close to the shopping centre. The numbers of butterflies counted in each area were 12, 29, 32, 10 and 17. The total area of the remnant vegetation was 250 m².

What is the best estimate of the total number of butterflies in the area?

- A. 20
- B. 100
- C. 500
- D. 25 000

Question 13

The scientist recommends that the shopping centre should be located more than 100 metres from the remnant vegetation. The scientist recommends this even though she is not sure whether it is necessary for the survival of the species.

This recommendation is an example of

- A. a Conservation Category.
- B. the Precautionary Principle.
- C. Population Viability Analysis.
- D. an Environmental Impact Assessment.

Use the following information to answer Questions 14 and 15.

The probability of extinction of two or more independent populations is found by multiplying together the probability of extinction of each individual population.

A rare frog species is found at only two separate sites. A population model was used to assess the likely survival of the species at the sites. The probability of extinction of the population at site A (population A) is 0.1, and the probability of extinction of the population at site B (population B) is 0.2. Population A has more individuals than population B.

Question 14

What is the overall probability that both populations will become extinct?

- A. 0.02
- B. 0.20
- C. 0.30
- D. 0.72

Question 15

Which of the following factors could make population A less likely to become extinct?

- A. more inbreeding
- B. larger population size
- C. greater loss of suitable habitat
- D. higher level of over-exploitation

Use the following information to answer Questions 16 and 17.

CITES is the Convention on International Trade in Endangered Species of wild flora and fauna. Australia is a signatory to CITES. While it has some effect, CITES has been less effective than many had hoped.

Question 16

A treaty in operation, such as CITES, could be less effective than expected because

- A. not all nations are signatories to many of these treaties.
- B. treaties never contribute to environmental improvement.
- C. environmental scientists are never involved in the preparation of these treaties.
- D. establishment of treaties involves protracted negotiations among many governments.

Question 17

Under the CITES treaty regular monitoring of the population numbers of endangered species is carried out. This is necessary because

- A. it keeps scientists employed.
- B. it ensures the treaty is being complied with.
- C. people like to see reports and features about endangered species.
- D. endangered species always have small and dispersed populations.

Question 18

Which of the following is the best reason for maintaining biodiversity?

- A. Humans benefit from a greater abundance of all species.
- B. Natural selection works better with very low biodiversity.
- C. High biodiversity reduces the enhanced greenhouse effect.
- D. Biodiversity is a key element in the sustainability of populations and species.

Question 19

Combustion of petrol in a car engine is an example of

- A. an exothermic reaction.
- B. an endothermic reaction.
- C. conversion of kinetic energy to mechanical energy.
- D. an almost 100% efficient conversion of the energy in petrol to the motion of the car.

Question 20

The Kyoto Protocol is a treaty for the reduction of greenhouse gases in the atmosphere.

Which of the following actions would assist in meeting the aims of the Kyoto Protocol?

- A. planting trees as a vegetation sink
- B. phasing out ozone-depleting chemicals
- C. replacing a nuclear power station with a wind-power generator farm
- D. installation of electrostatic precipitators in a coal-burning power station to remove small unburnt particles

SECTION B – Short-answer questions**Instructions for Section B**

Answer **all** questions in the spaces provided.

Question 1

- a. The natural greenhouse effect maintains the earth's temperature about 30°C higher than it would otherwise be. Explain how this occurs.

You must include a clearly labelled diagram. Your answer should refer to

- the types of incoming solar radiation
- the types of radiation re-emitted from the surface of the earth
- radiation absorbed in the atmosphere.

6 marks

- b. Name one greenhouse gas other than carbon dioxide that has increased due to human activity. Describe one source of the gas.

gas _____

source _____

2 marks

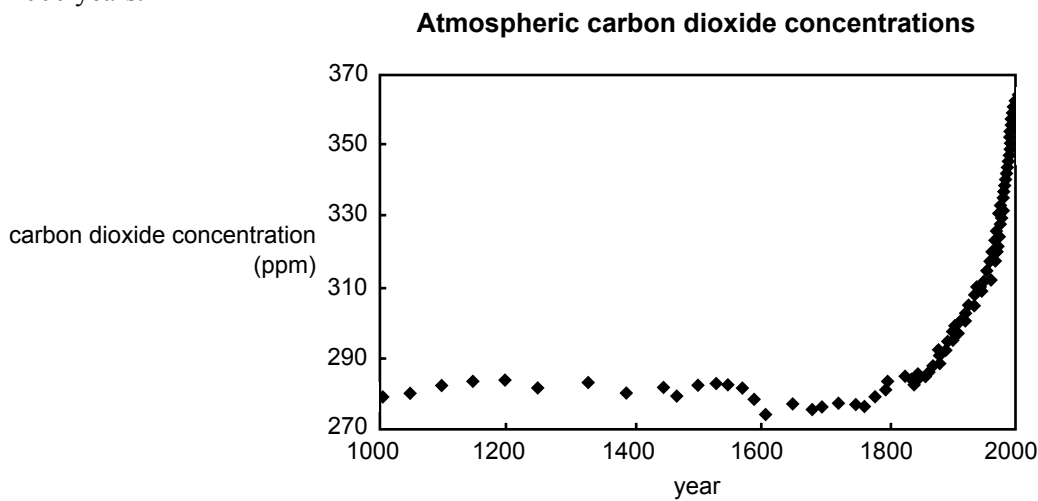
SECTION B – Question 1 – continued

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Use the following information to answer Questions 1c. and d.

The following graph shows how atmospheric concentrations of carbon dioxide have changed during the past 1000 years.



Graph courtesy of CSIRO Atmospheric Research

- c. Calculate the approximate percentage increase in carbon dioxide concentration between 1800 and 2000.

2 marks

- d. Give one reason why atmospheric concentrations of carbon dioxide have increased significantly during the past 200 years.

2 marks

- e. Describe two likely impacts of the enhanced greenhouse effect.

i. _____

ii. _____

2 marks

- f. Describe one strategy for reducing the impact of the enhanced greenhouse effect.

2 marks

Question 2

A scientist sets out to determine the amount of carbon dioxide released for each kilometre travelled by a petrol engine vehicle and a diesel engine vehicle. The table below presents the data needed for the calculation.

	Petrol engine	Diesel engine
Fuel efficiency (litres per 100 kilometres)	12.0	10.0
Kilograms of carbon dioxide emitted per litre of fuel	2.5	2.7

- a. Which engine releases less carbon dioxide when travelling 100 kilometres?

Show your calculations.

3 marks

Only 20% of the energy in petrol is converted into mechanical energy in a petrol engine.

- b. Describe what happens to the remaining 80% of the energy.

2 marks

- c. Give one reason why petrol engines are used in cars despite their low efficiency.

2 marks

Question 3

You have studied a fossil energy source and a non-fossil energy source. Use these sources to answer questions 3a.–3c.

- a.** Name one fossil energy source and one non-fossil energy source. Explain why each can be considered a fossil or non-fossil energy source. Comment on their emissions.

fossil

non-fossil

4 marks

- b.** Name **one** specific geographic location (town, region) where the non-fossil energy source mentioned in part **a.** could be economically used to supply a substantial part of the energy needs of the location. Explain why the source is suitable, including commenting on efficiency and economy.

4 marks

- c.** Discuss the contributions of the fossil energy source and the non-fossil energy source to the enhanced greenhouse effect. Your answer should include discussion of life cycle impacts and emission impacts.

3 marks

Question 4

- a. Name one renewable and one non-renewable energy source you have studied. Give a reason why each can be considered 'renewable' or 'non-renewable'.

renewable _____

reason _____

non-renewable _____

reason _____

4 marks

- b. A writer argues that all non-renewable energy sources should be banned. Outline and evaluate an argument for and an argument against the writer's position.

4 marks

Question 5

In 1998, a series of ponds was built along the course of a creek in a suburb of Melbourne to create an artificial wetland. Litter traps (constructed from metal) remove floating litter, and suspended sediments settle in the ponds.

- a.** Give one advantage and one disadvantage of the ponds.

3 marks

This wetland is part of a series of parks designed as a wildlife corridor, linking several natural areas together.

- b.** Name one possible advantage and one possible disadvantage of this wildlife corridor.

3 marks

A scientist argues that the construction of the ponds will increase ecosystem diversity.

- c.** Define the term ‘ecosystem diversity’. Explain how ecosystem diversity differs from other types of biodiversity (species and genetic) and how the ponds may assist ecosystem diversity.

4 marks

Question 6

The JAMBA treaty is an international agreement which aims to protect migratory birds that travel seasonally between Japan and Australia. Curlew sandpipers are one of numerous species listed under this treaty. As part of a monitoring program, the number of curlew sandpipers has been counted in two different years at a particular site (site 1). In both years, surveys were done on five different days. For each survey, the number of birds was estimated by counting the abundance in 10 sampling sections of the site. The estimated abundance on each day is shown in the table below.

Estimates in first year	Estimates in second year
100	150
110	100
60	130
120	160
90	180

- a. Calculate the average (mean) abundance in each year. Show your working.
- first year

second year

4 marks

A scientist conducted a statistical test to determine whether there had been a change in abundance. He concluded that there had been a statistically significant change.

- b. What type of statistical error might the scientist have made in concluding this? Give a reason for your answer. Your answer should include reference to the above data, and make mention of Type I (falsely rejecting the null hypothesis) and Type II (falsely accepting the null hypothesis) errors.

3 marks

- c. Suggest two ways that the scientist could increase the reliability of this statistical test.

2 marks

- d. Explain why this international treaty could be important for conserving these migratory birds in Australia.

3 marks

Scientists often need to compare the genetic and other forms of biodiversity of different sites. These sites may be of different sizes and therefore have different numbers of birds and species. Because of these differences mathematical indices are often used for comparisons.

Jaccard's index is one such measure. It enables the species composition and diversity of two sites, site A and site B, to be compared. Jaccard's index is equal to the proportion of the species at the two sites that are found at both, that is

$$\text{Jaccard's index} = \frac{\text{number of species that are common to both sites (that is, found at both A and B)}}{\text{total number of species (if sites A and B were combined)}}$$

In another study, the scientist wanted to compare the species diversity of site 1 to the species diversity of two other sites (site 2 and site 3). The species seen at each of these sites are listed in the table below.

site 1	site 2	site 3
curlew sandpiper	curlew sandpiper	curlew sandpiper
sharptailed sandpiper		
greenshank		greenshank
	red-necked stint	red-necked stint
	Japanese snipe	
	sanderling	
	ringed plover	ringed plover

- e. Calculate Jaccard's index to measure the similarity between site 1 and site 2 in terms of their species composition. Show your working.

2 marks

SECTION B – Question 6 – continued

- f. Calculate Jaccard's index to measure the similarity between site 1 and site 3. Show your working.

2 marks

- g. Briefly comment on what these two indices indicate about the similarity of the sites.

2 marks

